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Mass Rearing of *Menochilus sexmaculatus* Fabricus (Coleoptera: Coccinellidae) on Natural and Artificial Diets

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ABSTRACT

The average prey consumption of five developmental stages of *Menochilus sexmaculatus* on live aphids (*Myzys persicae*) was 7, 35, 42, 105, and 240 per day, respectively. The predator acquired significantly higher survival and faster development when feeding on live aphids. The average weight gain was superior in response to the natural diet. However, the rate of egg production was lower on feeding dried and frozen prey of the same species and no eggs were found in response to chicken liver diet. The average longevity was 166 days fed on natural diet in comparison with artificial diet, which was 63 days. The artificial diet could be used to overcome the scanty period of natural feeding resource but not suitable for the reproduction.

Key Words: *Menochilus sexmaculatus*; Diet; Chicken; Aphids; Mass rearing

INTRODUCTION

Menochilus sexmaculatus is an important predator of aphids, coccicids, psyllids, and found in many ecosystems of South East Asia (Parker *et al.,* 1976; Gupta & Yadava, 1989; Lokhanda & Mohan, 1990; Hussein *et al.,* 1991; Maisini *et al.,* 1994). It is an effective predator to be used as a bio-control agent but the major challenge is its mass rearing and augmentation. In previous studies, the quality and quantity of natural diets were tested on various predator species with supplemented artificial diets (Smith, 1965; Hodek, 1973; Niijima *et al.,* 1986; Ali *et al.,* 1992; Rizvi *et al.,* 1992; Elliott *et al.,* 2000). Honey bee brood drone was also tested earlier by Okada and Matsuka (1973) but no successful results were obtained. The availability of natural diet (aphids) for the mass rearing of the predator is an expensive method not feasible to carry on sustainable basis. The artificial diet of preserved natural prey, chemically formulated or high protein and cholesterol diets could bear minimum expense in comparison with natural diet. Since long, a need was felt to investigate the various formulations of artificial diets, which could contribute in mass rearing of predator in case of shortage of natural prey.

It is a step forward in seeking the alternate resources of predators feed with the aim to test the response of predators development and reproduction to some artificial diets verses the natural prey *Myzus persicae*.

MATERIALS AND METHODS

Adult *M. sexmaculatus* were collected from the agricultural fields and reared in the Integrated Pest Management Laboratory (IPM). The field collected material was sorted out in the laboratory and pairs were selected for oviposition. The selected pairs were kept in separate cages (oviposition cages) to get the batches of eggs for single cohort offspring's to minimize the variation in the experiment. The beetles were raised on single prey *M. persicae*. The cabbage seedlings were used as host plants for rearing these aphids. The seedlings of cabbage were raised in an isolated growth chamber illuminated 12:12 L:D. Individual predator was kept in a plastic containers measuring (1.5 cm deep) covered with a ventilated lid. These containers were provided with filter papers lined up with moist streaks. The filter papers were replaced every day to maintain the hygienic conditions. Each container having a single predator was used for various feeding trials and considered as one replicate. The control treatments were fed with live aphids. The artificial diet was prepared in droplets. The droplet size was maintained at 2.6 to 2.8 mm equal to the average size of aphid. This was done after pre-tested behaviour of all developmental stages. Both larvae and adult devour the whole prey instead of making the small pieces. The vitamin diet components were added to an aqueous solution of nicotinic acid and riboflavin in powdered chicken liver.

Four parameters of the experimental protocols used were a) feeding on live aphids (La), b) feeding on dried aphids (Da), c) feeding on frozen aphids (Fa) and d) feeding on chicken liver (Cl)

Preparation of dried aphids. Aphids from stock culture were collected and killed by keeping at low temperature for 24 h. The dead aphids were placed in the oven at 55ºC for 4 h. The dried prey was stored in a plastic container and kept in the refrigerator at 2ºC.

Preparation of frozen aphids. Live aphids taken from the laboratory stock culture were placed at low temperature below 0ºC in a close container measuring (18 X 6 cm). These containers were kept in the freezer for 24 h. After getting complete frozen, the dead aphids were divided into small portion and were shifted into small

containers of (9 x 3 cm) and kept on the same temperature for entire period of the experiment.

Preparation of the artificial diet. Five kilogram chicken liver was kept in the oven at 90ºC for 2 h to make it complete dry before blended in to powder form. Complete dry form of chicken liver was the most appropriate for making homogenized powder. Out of total dried material, 500 g blended powder was separated and mixed with 200 mL of sucrose solution (5% wet volume) and again blended for 5-10 min until a paste is formed. The resulting paste was sealed in an aluminum foil packet and stored in frozen form. A single layer of parafilm (insulating material) was wrapped around the cylindrical form of diet materiel. No antibiotic or preservative was used. A 50 g of preserved chicken liver materiel was taken every day and melted in sucrose solution in a test tube using water bath for heating.

The melted material was converted in to small and equal size droplets by using the small capillary tubes. The droplets were placed on parafilm sheet on equal distance. The droplets were prepared every day to avoid the contamination. Small pieces of parafilm were placed in petri dishes to offer them in separate feeding arena.

RESULTS AND DISCUSSION

The natural and artificial diets were tested on five developmental stages of *M. sexmaculatus* Fab. All four immature stages (first four instars) showed significantly better response in acquiring the high survival rate and faster development when fed on live aphids (*M. persicae*) compared with artificial diet consisting of dried aphids, frozen aphids of same species and chicken liver diet. The impact of natural diet (La) in average weight gain of $1^{st} - 4^{th}$ instars larvae was much higher over the rest of the treatments (Fig. 1.). The survival percentage was found inferior (25-30%) when the predator fed on Da, Fa and Cl (Fig. 2.). The egg production remain lower in all treatments except the control i.e. natural diet (La).

These results are in concur with Allen (1985) that beef liver was reported as nutritionally adequate diet for predator development but no egg production was obtained. Further, he concluded that the high fats and cholesterol contents are quite important for the fertility and fecundity of predators.

The rate of pupation was much lower in response to all three treatments. Sucrose only could support in survival of the adult up to 35 days. The average longevity was found 166 days on La over highest 63 days on artificial diet. The result of present study not comply with (Hagen, 1962) who has reported longevity on artificial diet much longer over those reared on natural diets.

The difference in the reproduction period was all due to the difference in food intake and predators feeding behaviour. These results contradict with Niijima (1979) who had tested the honey bee brood drone powder and reported 11 successful generations with out any reduction in viability and fecundity.

Fig. 1. Average weight gain by larval instars of *Menochilus sexmaculatus*

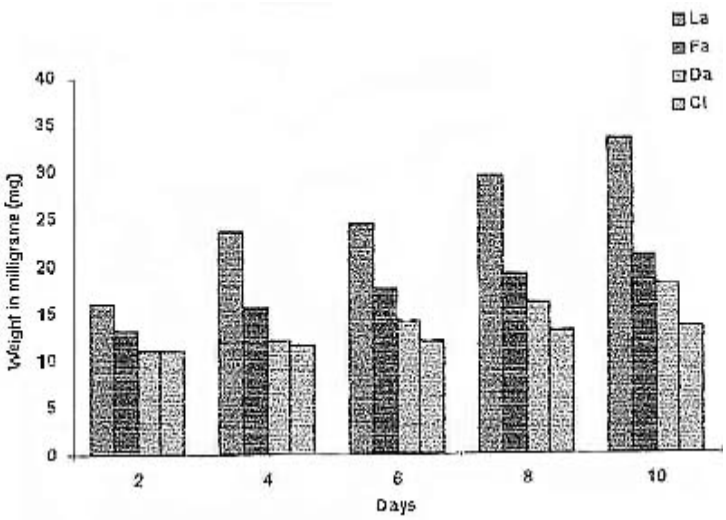
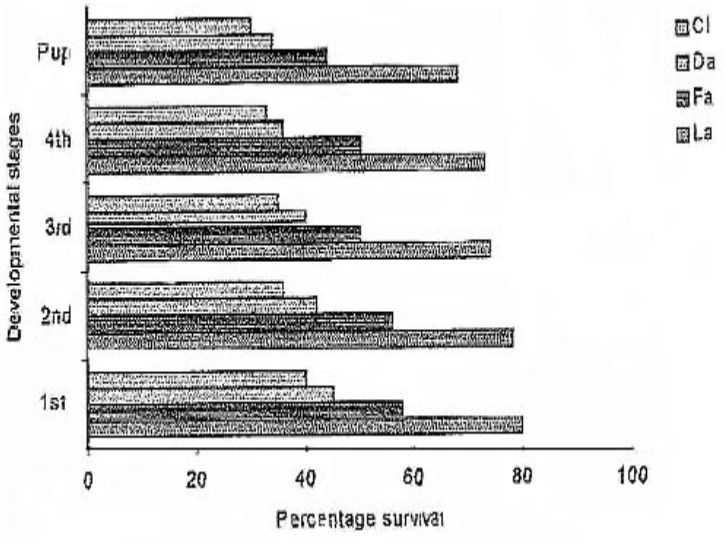


Fig. 2. The percentage survival during various developmental stages in response to four different diets



La = Live aphids, Fa = Frozen aphids, Da = Dried aphid , Cl = Chicken liver

Table I. The effect of various diets on the development and egg production of *Menochilus sexmaculatus* Fab.

Treatments	Pre-Oviposition (POP) Days (S.E)	Oviposition (OP) Days (S.E)	Egg laying /day (S.E)	Longevity Days (S.E)
Live aphids (La)	4.7 ± 0.46	28.5 ± 1.33	30.5 ± 1.59	166 ± 6.4
Frozen aphids (Fa)	18.5 ± 1.2	34 ± 1.84	6.4 ± 0.48	63 ± 3.5
Dried aphids(Da)	21.6 ± 1.6	30 ± 1.66	2.5 0±.065	46.5 ± 4.2
Chicken live (Cl)	0 ± 0.00	0 ± 0.00	0 ± 0.00	42.6 ± 3.8
Sucrose (Su)	0 ± 0.00	0 ± 0.00	0 ± 0.00	36.5 ± 2.69

The present study, however, revealed that the development and reproduction of successive generations of *M. sexmaculatus* is mainly dependent on the live prey. The dried and frozen prey diet prepared from the same species has no role in reproduction. It was also observed that the pre-oviposition, oviposition period and length of stadium was greatly extended in response to artificial diet over natural prey (Table I). A quick growth response to all developmental stages was observed in response to La over Fa, Da and Cl.

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